

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-155714

(43)Date of publication of application : 20.06.1995

(51)Int.Cl.

B08B 3/12
G03F 1/08
H01L 21/304

(21)Application number : 05-339766

(71)Applicant : NIKON CORP

(22)Date of filing : 06.12.1993

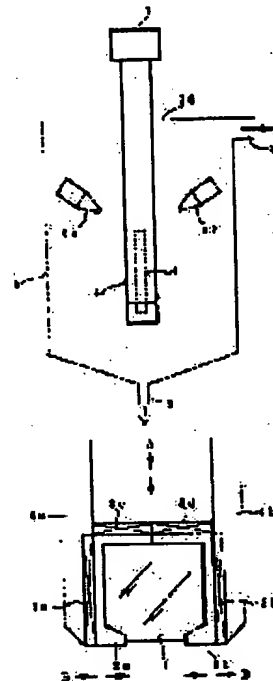
(72)Inventor : SAKUMA AKIHIKO

(54) ULTRASONIC WASHING DEVICE

(57)Abstract:

PURPOSE: To apply ultrasonic vibrations to a wash without attenuating the energy of these vibrations by applying the ultrasonic vibrations by a vibrating means via a holding means for holding the wash in a washing chamber to the wash and injecting the liquid to the surface of the wash by an injecting means.

CONSTITUTION: A substrate 1 supported by a substrate supporting arm 4 is transported to an upper position of a washing chamber 5 by a transporting device and is then lowered via an aperture 20 of the washing chamber 5 so that the substrate 1 is positioned in the prescribed position in the washing chamber 5. An ultrasonic signal transmitter is driven in this state to transmit the ultrasonic vibrations generated by ultrasonic vibrator transducers 3a to 3d to the substrate 1 via substrate holding parts 2a and 2b, thereby peeling the foreign matter stuck far on the substrate surface or putting the foreign matter in an easily peelable state. Next, pure water is injected from liquid injection nozzles 6a, 6b to remove the foreign matter on the substrate surface and simultaneously to cool the substrate holding parts 2a, 2b where the heat is liable to be generated. The injection liquid after the injection is discharged together with the foreign matter from a liquid discharge port 9.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

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CLAIMS

[Claim(s)]

[Claim 1] The ultrasonic cleaner characterized by having the maintenance means for holding the washed body within a washing chamber and this washing chamber, the oscillating means for giving supersonic vibration to said washed body through this maintenance means, and the injection means for injecting a liquid on the front face of said washed body.

[Claim 2] Said maintenance means is an ultrasonic cleaner according to claim 1 characterized by consisting of high matter of the atomic filling factor which has the cubic-closest-packing crystal structure or hexagonal close packing crystal structure.

[Claim 3] Said oscillating means is an ultrasonic cleaner according to claim 1 or 2 characterized by being the ultrasonic vibrator arranged so that supersonic vibration might be given in the two directions almost parallel to the front face of said washed body.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] Especially this invention relates to the ultrasonic cleaner of various substrates, such as a photo mask and a reticle, about an ultrasonic cleaner.

[0002]

[Description of the Prior Art] If foreign matters, such as dust adhering to glass substrates, such as a reticle and a photo mask, are left, these foreign matters will be imprinted on a wafer and will cause a defect of the wafer manufactured. Then, the washing approach of using supersonic vibration is conventionally proposed as one approach of washing the contamination adhering to a substrate.

[0003] Drawing 4 is drawing showing roughly the so-called configuration of a liquid immersion type ultrasonic cleaner. The equipment of drawing 4 is equipped with the washing chamber 10. An ultrasonic vibrator 12 is formed in the pars basilaris ossis occipitalis of the washing chamber 10, and the liquid 11 as an ultrasonic transfer medium is held in the washing chamber 10. With this equipment, if an ultrasonic vibrator 12 is operated while the substrate 1 which is the washed body held by the substrate support arm 4 had been made immersed into a liquid 11, a supersonic wave will get across to the front face of a substrate 1 through a liquid 11. The foreign matter adhering to the front face of a substrate 1 is removed by operation of this supersonic vibration.

[0004] On the other hand, drawing 5 is drawing showing roughly the so-called configuration of a liquid jet type ultrasonic cleaner. The equipment of drawing 5 is equipped with the washing chamber 10. The nozzle 14 which has opening of the shape of an ultrasonic vibrator 13 and a slit is formed in the wall of the washing chamber 10. With this equipment, the substrate 1 which is the washed body held by the substrate support arm 4 is held in the predetermined location in the washing chamber 10, and the liquid on which the supersonic wave was made to superimpose (direction which counters the front face of a substrate 1) is spouted toward the front face of a substrate 1 from opening of the shape of a slit of a nozzle 14, operating an ultrasonic vibrator 13. The foreign matter adhering to the front face of a substrate 1 is removed by operation of the liquid on which this supersonic wave was made to superimpose.

[0005]

[Problem(s) to be Solved by the Invention] In the above conventional ultrasonic cleaners, since an ultrasonic transfer medium was a liquid, the kinetic energy by supersonic vibration was absorbed by the liquid molecule, it was easy to decrease it, and there was un-arranging [that a desired cleaning effect could not be acquired]. Especially, in above-mentioned liquid immersion type ultrasonic cleaning, the foreign matter which exfoliated from the substrate front face by washing floats in liquid. For this reason, there was un-arranging [that the foreign matter which once exfoliated will adhere to a substrate front face again].

[0006] Moreover, there was un-arranging [that it was difficult to give supersonic vibration to a liquid and to make a supersonic wave superimpose also in above-mentioned liquid jet type ultrasonic cleaning, it was much more difficult to make a supersonic wave superimpose when blowing off and washing a lot

of liquids especially, and a cleaning effect will decline remarkably]. This invention aims at offering an ultrasonic cleaner which resoiling by the foreign matter which was formed in view of the above-mentioned technical problem, could give to the washed body, without attenuating the energy of supersonic vibration substantially, and was removed does not generate.

[0007]

[Means for Solving the Problem] In order to solve said technical problem, in this invention, the ultrasonic cleaner characterized by having the maintenance means for holding the washed body within a washing chamber and this washing chamber, the oscillating means for giving supersonic vibration to said washed body through this maintenance means, and the injection means for injecting a liquid on the front face of said washed body is offered.

[0008] According to the desirable mode, a maintenance means consists of high matter of the atomic filling factor which has hexagonal close packing crystal structures, such as cubic closest packing, such as aluminum, nickel, and copper, or zinc, and magnesium. Moreover, as for an oscillating means, it is desirable that it is the ultrasonic vibrator arranged so that supersonic vibration might be given in the two directions almost parallel to the front face of said washed body.

[0009]

[Function] In the ultrasonic cleaner of this invention, supersonic vibration is given to a substrate through a maintenance means to hold the substrate which is the washed body. That is, it can tell efficiently a substrate by using a solid-state like a maintenance means, without attenuating the ultrasonic vibrational energy of vibrator substantially. As for a maintenance means, it is desirable to consist of solid-state crystal matter which has the matter which has the high crystal structure of an atomic filling factor so that attenuation of the ultrasonic vibrational energy by oscillating absorption may decrease most, i.e., hexagonal close-packed structure, and cubic-closest-packing structure.

[0010] Thus, the foreign matter which exfoliated from the substrate front face according to an operation of supersonic vibration, or was exfoliating is promptly removed and discharged from a substrate front face by injecting a liquid towards a substrate front face, giving supersonic vibration to a substrate through a maintenance means. For this reason, resoiling which was generated in the conventional technique is avoided. Moreover, it is solvable also about the problem of the heat generated when giving supersonic vibration to a solid-state with the cooling effect of the liquid injected. That is, it can cool by injecting a liquid like pure water to a part for the attaching part which touches a substrate at least among substrate maintenance means, and transfer of the harmful heat to a substrate can be avoided. furthermore -- for example, the case of the former which makes supersonic vibration act only in the one direction by constituting so that supersonic vibration can be made to act in the two directions parallel to a substrate front face (coincidence -- or alternation) -- comparing -- a substrate front face to a foreign matter -- exfoliating -- being easy -- the so-called exfoliation effectiveness doubles.

[0011]

[Example] The example of this invention is explained based on an accompanying drawing. Drawing 1 is drawing which explains typically the configuration of the ultrasonic cleaner concerning the example of this invention. Moreover, drawing 2 is drawing which explains the configuration of the substrate maintenance means of drawing 1 roughly. The equipment of drawing 1 is equipped with the washing chamber 5. Opening 20 is formed in the upper part of the washing chamber 5, and through this opening 20, a substrate 1 like the reticle which is the washed body is supported by the substrate support arm 4, and is introduced in the washing chamber 5. The substrate support arm 4 is connected with a driving gear 7, and it is constituted so that round trip-under drawing Nakagami migration can be performed within the washing chamber 5.

[0012] An exhaust port 8 is established in the side-attachment-wall upper part of the washing chamber 5, and the effluent opening 9 is formed in the lower part. Moreover, in the washing chamber 5, two liquid injection nozzles 6a and 6b are formed. It can connect with the liquid feeder (un-illustrating) which supplies a liquid like pure water, and each liquid injection nozzle 6 can inject a liquid now toward the front face of the substrate 1 held in the predetermined location. The substrate maintenance means is equipped with the substrate support arms 4a and 4b of a pair as shown in drawing 2. Inside [lower

limit] the substrate support arms 4a and 4b of a pair; substrate attaching part 2a and 2b are prepared, respectively, and it is constituted so that a substrate 1 can be grasped with this substrate attaching part 2a and 2b.

[0013] As for substrate attaching part 2a and 2b, it is desirable to consist of matter which has the high matter of an atomic filling factor, for example, cubic-closest-packing structure like nickel, aluminum, and Cu, and hexagonal close-packed structure like Zn and Mg so that it can tell a substrate 1, without attenuating ultrasonic vibrational energy substantially. In addition, ultrasonic vibrator 3a is prepared in the direction of the vertical in drawing, and ultrasonic vibrator 3c is prepared in the drawing Nakamizu common direction at substrate attaching part 2a. On the other hand, ultrasonic vibrator 3b is prepared in the direction of the vertical in drawing, and 3d of ultrasonic vibrators is prepared in the drawing Nakamizu common direction at substrate attaching part 2b. In this way, the substrate 1 is constituted so that supersonic vibration may be carried out to the direction of the vertical in drawing (an arrow head A shows), and a horizontal direction (an arrow head B shows) through substrate attaching part 2a and 2b.

[0014] Actuation of the ultrasonic cleaner of this example which has the above configuration is explained below. The substrate 1 supported by the substrate support arm 4 is conveyed by the transport device (un-illustrating) to the upper part location of the washing chamber 5. Subsequently, the substrate support arm 4 descends through the opening 20 of the washing chamber 5 with a driving gear 7, and the substrate 1 supported by the substrate support arm 4 is held in the predetermined location in the washing chamber 5. If a substrate 1 is held in the predetermined location in the washing chamber 5, an ultrasonic vibrator 3 will start supersonic vibration with ultrasonic oscillation equipment (un-illustrating).

Propagation and a substrate 1 carry out supersonic vibration of the supersonic vibration of an ultrasonic vibrator 3 to a substrate 1 efficiently through substrate attaching part 2a and 2b to the direction of the vertical in drawing (an arrow head A shows), and a horizontal direction (an arrow head B shows).

[0015] According to an operation of supersonic vibration, the foreign matter adhering to a substrate front face will be in the condition of exfoliating or being easy to exfoliate. On the other hand, while the substrate support arm 4 repeats round trip-under drawing Nakagami migration with a driving gear 7, from the liquid injection nozzle 6, pure water is injected toward the front face of a substrate 1, substrate attaching part 2a, and 2b, so that the supersonic vibration of an ultrasonic vibrator 3 may be interlocked with.

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EFFECT OF THE INVENTION

[Effect] As explained above, since the solid-state with little oscillating absorption as an ultrasonic transfer medium is used, with the ultrasonic cleaner of this invention, ultrasonic vibrational energy can be given to a substrate very efficiently. Moreover, since a liquid is injected for a substrate front face and a substrate maintenance means at the same time it gives supersonic vibration, the foreign matter which exfoliated in supersonic vibration is incorporated by the liquid, and is discharged out of a washing chamber. Therefore, resoiling of the substrate by the once removed foreign matter is avoided, and cooling of a substrate maintenance means is performed effectively. Furthermore, since supersonic vibration is given in the two directions by turns simultaneous to a substrate, the exfoliation effectiveness of a foreign matter doubles.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In the above conventional ultrasonic cleaners, since an ultrasonic transfer medium was a liquid, the kinetic energy by supersonic vibration was absorbed by the liquid molecule, it was easy to decrease it, and there was un-arranging [that a desired cleaning effect could not be acquired]. Especially, in above-mentioned liquid immersion type ultrasonic cleaning, the foreign matter which exfoliated from the substrate front face by washing floats in liquid. For this reason, there was un-arranging [that the foreign matter which once exfoliated will adhere to a substrate front face again].

[0006] Moreover, there was un-arranging [that it was difficult to give supersonic vibration to a liquid and to make a supersonic wave superimpose also in above-mentioned liquid jet type ultrasonic cleaning, it was much more difficult to make a supersonic wave superimpose when blowing off and washing a lot of liquids especially, and a cleaning effect will decline remarkably]. This invention aims at offering an ultrasonic cleaner which resoiling by the foreign matter which was formed in view of the above-mentioned technical problem, could give to the washed body, without attenuating the energy of supersonic vibration substantially, and was removed does not generate.

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MEANS

[Means for Solving the Problem] In order to solve said technical problem, in this invention, the ultrasonic cleaner characterized by having the maintenance means for holding the washed body within a washing chamber and this washing chamber, the oscillating means for giving supersonic vibration to said washed body through this maintenance means, and the injection means for injecting a liquid on the front face of said washed body is offered.

[0008] According to the desirable mode, a maintenance means consists of high matter of the atomic filling factor which has hexagonal close packing crystal structures, such as cubic closest packing, such as aluminum, nickel, and copper, or zinc, and magnesium. Moreover, as for an oscillating means, it is desirable that it is the ultrasonic vibrator arranged so that supersonic vibration might be given in the two directions almost parallel to the front face of said washed body.

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OPERATION

[Function] In the ultrasonic cleaner of this invention, supersonic vibration is given to a substrate through a maintenance means to hold the substrate which is the washed body. That is, it can tell efficiently a substrate by using a solid-state like a maintenance means, without attenuating the ultrasonic vibrational energy of vibrator substantially. As for a maintenance means, it is desirable to consist of solid-state crystal matter which has the matter which has the high crystal structure of an atomic filling factor so that attenuation of the ultrasonic vibrational energy by oscillating absorption may decrease most, i.e., hexagonal close-packed structure, and cubic-closest-packing structure.

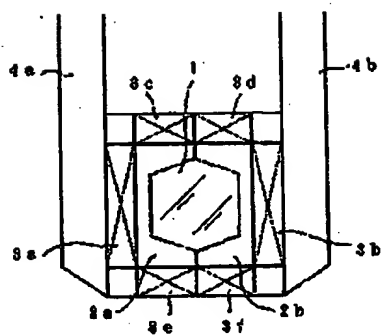
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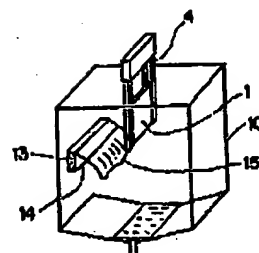
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特開平7-155714

【図3】



【図5】



(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平7-155714

(43) 公開日 平成7年(1995)6月20日

(51) Int. Cl. ⁴	識別記号	庁内整理番号	F I	技術表示箇所
B 0 8 B 3/12		B 2119-3B		
G 0 3 F 1/08		X		
H 0 1 L 21/304	3 4 1	M		
		N		

審査請求 未請求 請求項の数 3 F D (全 5 頁)

(21) 出願番号 特願平5-339768

(22) 出願日 平成5年(1993)12月6日

(71) 出願人 000004112

株式会社ニコン

東京都千代田区丸の内3丁目2番3号

(72) 発明者 佐久間 明彦

東京都品川区西大井1丁目6番3号 株式会社ニコン大井製作所内

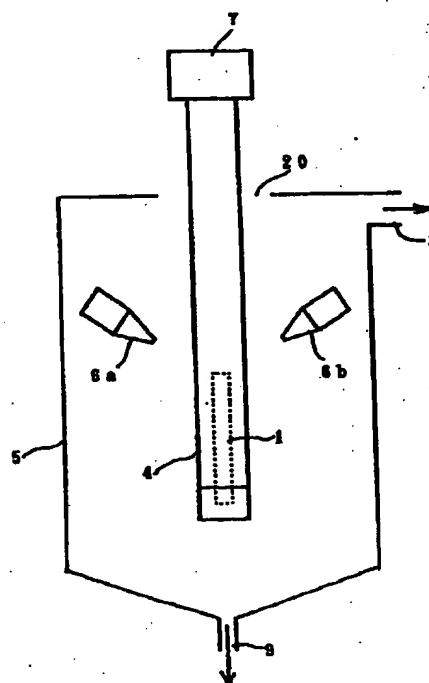
(74) 代理人 弁理士 山口 孝雄

(54) 【発明の名称】 超音波洗浄装置

(57) 【要約】

【目的】 超音波振動のエネルギーを実質的に減衰させることなく被洗浄体に付与することができ、且つ除去した異物による再汚染が発生しないような、超音波洗浄装置を提供することを目的とする。

【構成】 本発明の超音波洗浄装置は、洗浄チャンバと、該洗浄チャンバ内で被洗浄体を保持するための保持手段と、該保持手段を介して前記被洗浄体に超音波振動を付与するための振動手段と、前記被洗浄体の表面に液体を噴射するための噴射手段とを備えていることを特徴とする。



【特許請求の範囲】

【請求項1】 洗浄チャンバと、該洗浄チャンバ内で被洗浄体を保持するための保持手段と、該保持手段を介して前記被洗浄体に超音波振動を付与するための振動手段と、前記被洗浄体の表面に液体を噴射するための噴射手段とを備えていることを特徴とする超音波洗浄装置。

【請求項2】 前記保持手段は、立方最密充填結晶構造または六方最密結晶構造を有する原子充填率の高い物質からなることを特徴とする請求項1に記載の超音波洗浄装置。

【請求項3】 前記振動手段は、前記被洗浄体の表面にほぼ平行な2つの方向に超音波振動を付与するように配列された超音波振動子であることを特徴とする請求項1または2に記載の超音波洗浄装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は超音波洗浄装置に関し、特にフォトマスク、レチクルなどの各種基板の超音波洗浄装置に関する。

【0002】

【従来の技術】レチクルやフォトマスク等のガラス基板に付着した塵埃等の異物を放置すると、これらの異物がウェハ上に転写され、製造されるウェハの欠陥の原因となる。そこで、基板に付着した汚染物を洗浄する1つの方法として、超音波振動を利用する洗浄方法が従来より提案されている。

【0003】図4は、いわゆる液浸漬式超音波洗浄装置の構成を概略的に示す図である。図4の装置は、洗浄チャンバ10を備えている。洗浄チャンバ10の底部には超音波振動子12が設けられ、洗浄チャンバ10内には超音波伝達媒体としての液体11が収容されている。この装置では、基板支持アーム4によって保持された被洗浄体である基板1を液体11中に浸漬させたまま超音波振動子12を作動させると、超音波が液体11を媒体として基板1の表面に伝わる。この超音波振動の作用により、基板1の表面に付着した異物が除去される。

【0004】一方、図5は、いわゆる液噴出式超音波洗浄装置の構成を概略的に示す図である。図5の装置は、洗浄チャンバ10を備えている。洗浄チャンバ10の壁部には、超音波振動子13およびスリット状の開口部を有するノズル14が設けられている。この装置では、基板支持アーム4によって保持された被洗浄体である基板1を洗浄チャンバ10内の所定位置に保持し、超音波振動子13を作動させながら超音波を重畳（基板1の表面に対向する方向）させた液体をノズル14のスリット状の開口部から基板1の表面に向かって噴出する。この超音波を重畳させた液体の作用により、基板1の表面に付着した異物が除去される。

【0005】

【発明が解決しようとする課題】前述のような従来の超

音波洗浄装置では、超音波伝達媒体が液体であるため、超音波振動による運動エネルギーが液体分子に吸収されて減衰し易く、所望の洗浄効果を得ることができないという不都合があった。特に、上述の液浸漬式超音波洗浄では、洗浄によって基板表面から剥離した異物が液中に浮遊する。このため、一旦剥離した異物が再び基板表面に付着してしまうという不都合があった。

【0006】また、上述の液噴出式超音波洗浄においても、液体に超音波振動を与えて超音波を重畳させることが困難であり、特に大量の液体を噴出して洗浄するような場合には超音波を重畳させることが一層困難であり洗浄効果が著しく減退してしまうという不都合があった。本発明は、前述の課題に鑑みてなされたものであり、超音波振動のエネルギーを実質的に減衰させることなく被洗浄体に付与することができ、且つ除去した異物による再汚染が発生しないような、超音波洗浄装置を提供することを目的とする。

【0007】

【課題を解決するための手段】前記課題を解決するために、本発明においては、洗浄チャンバと、該洗浄チャンバ内で被洗浄体を保持するための保持手段と、該保持手段を介して前記被洗浄体に超音波振動を付与するための振動手段と、前記被洗浄体の表面に液体を噴射するための噴射手段とを備えていることを特徴とする超音波洗浄装置を提供する。

【0008】好ましい態様によれば、保持手段は、アルミニウム、ニッケル、銅などの立方最密充填または亜鉛、マグネシウムなどの六方最密結晶構造を有する原子充填率の高い物質からなる。また、振動手段は、前記被洗浄体の表面にほぼ平行な2つの方向に超音波振動を付与するように配列された超音波振動子であるのが好ましい。

【0009】

【作用】本発明の超音波洗浄装置では、被洗浄体である基板を保持する保持手段を介して超音波振動を基板に付与する。すなわち、保持手段のような固体を用いることにより、振動子の超音波振動エネルギーを実質的に減衰させることなく効率的に基板に伝えることができる。保持手段は、振動吸収による超音波振動エネルギーの減衰が最も少なくなるように原子充填率の高い結晶構造を有する物質、すなわち六方最密構造または立方最密充填構造を有する固体結晶物質からなるのが好ましい。

【0010】このように、保持手段を介して基板に超音波振動を付与しながら、基板表面に向けて液体を噴射することにより、超音波振動の作用により基板表面から剥離した、あるいは剥離しなかった異物は、速やかに基板表面から除去・排出される。このため、従来技術において発生したような再汚染が回避される。また、固体に超音波振動を与える場合に発生する熱の問題についても、噴射される液体の冷却効果により解決することができ

る。すなわち、基板保持手段のうち少なくとも基板に接する保持部分に純水のような液体を噴射することにより冷却し、基板への有害な熱の伝達を回避することができる。さらに、たとえば基板表面に平行な2つの方向に（同時にあるいは交互に）超音波振動を作用させることができるように構成することにより、1つの方向のみに超音波振動を作用させる従来の場合と比べて、基板表面から異物が剥離し易くなり、いわゆる剥離効果が倍増する。

【0011】

【実施例】本発明の実施例を、添付図面に基いて説明する。図1は、本発明の実施例にかかる超音波洗浄装置の構成を模式的に説明する図である。また、図2は、図1の基板保持手段の構成を概略的に説明する図である。図1の装置は、洗浄チャンバ5を備えている。洗浄チャンバ5の上部には開口部20が設けられ、この開口部20を介して被洗浄体であるレチクルのような基板1が基板支持アーム4に支持されて洗浄チャンバ5内に導入されるようになっている。基板支持アーム4は駆動装置7に連結され、洗浄チャンバ5内で図中上下往復移動ができるように構成されている。

【0012】洗浄チャンバ5の側壁上部には排気口8が設けられ、下部には排液口9が設けられている。また、洗浄チャンバ5内には2つの液噴射ノズル6aおよび6bが設けられている。各液噴射ノズル6は、たとえば純水のような液体を供給する液供給装置（不図示）に接続され、所定位置に保持された基板1の表面に向かって液体を噴射することができるようになっている。基板保持手段は、図2に示すように、一対の基板支持アーム4aおよび4bを備えている。一対の基板支持アーム4aおよび4bの下端内側には、それぞれ基板保持部2aおよび2bが設けられ、この基板保持部2aおよび2bによって基板1を把持することができるように構成されている。

【0013】基板保持部2aおよび2bは、超音波振動エネルギーを実質的に減衰させることなく基板1に伝えることができるように原子充填率の高い物質、たとえばNi、Al、Cuのような立方最密充填構造またはZn、Mgのような六方最密構造を有する物質からなるのが好ましい。なお、基板保持部2aには、図中鉛直方向に超音波振動子3aが図中水平方向に超音波振動子3cが設けられている。一方、基板保持部2bには、図中鉛直方向に超音波振動子3bが図中水平方向に超音波振動子3dが設けられている。こうして、基板1は基板保持部2aおよび2bを介して図中鉛直方向（矢印Aで示す）および水平方向（矢印Bで示す）に超音波振動するように構成されている。

【0014】以上の構成を有する本実施例の超音波洗浄装置の動作について、以下に説明する。基板支持アーム4に支持された基板1が、搬送装置（不図示）により洗

浄チャンバ5の上方位置まで搬送される。次いで、駆動装置7により基板支持アーム4は洗浄チャンバ5の開口部20を介して下降し、基板支持アーム4によって支持された基板1が洗浄チャンバ5内の所定位置に保持される。基板1が洗浄チャンバ5内の所定位置に保持されると、超音波振動子3が超音波発振装置（不図示）によって超音波振動を開始する。超音波振動子3の超音波振動は基板保持部2aおよび2bを介して基板1に効率的に伝わり、基板1は図中鉛直方向（矢印Aで示す）および水平方向（矢印Bで示す）に超音波振動する。

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【0015】超音波振動の作用により、基板表面に付着していた異物は剥離し、あるいは剥離し易い状態となる。一方、超音波振動子3の超音波振動と連動するように、基板支持アーム4は駆動装置7により図中上下往復移動を繰り返すとともに、液噴射ノズル6からは純水が基板1の表面および基板保持部2aおよび2bに向かって噴射される。こうして、基板1の表面からすでに剥離して基板表面の周辺で浮遊している異物および基板表面から剥離しかかっている異物が液噴射の作用により除去されると同時に、超音波振動を受けて熱が発生し易い基板保持部2aおよび2bが有効に冷却される。

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【0016】基板1の表面から剥離して落下した異物および噴射液に取り込まれて基板表面から除去された異物は、排液口9を介して洗浄チャンバ5の外部に排出される。また、洗浄チャンバ5内で発生するミストは、排気口8を介して洗浄チャンバ5の外部に排出される。こうして、基板1の表面から一旦除去された異物が基板1の表面に再び付着する、いわゆる再汚染が回避される。

【0017】なお、噴射ノズルから噴射される液体として、基板の帯電防止のために、 CO_2 や O_3 を溶解させた純水などを用いるのが好ましい。また、アンモニア水や溶剤などの化学的溶解力を有する薬液を使用してもよい。噴射ノズルは、スリット状開口部を有するタイプであってもよいし、扇状に噴射するような開口部を有するタイプであってもよい。また、基板の全表面および基板保持部を網羅するように扇状噴射タイプの噴射ノズルを複数個適宜配置することにより、洗浄工程中の基板の往復移動を回避することもできる。

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【0018】次に、基板保持手段の変形例を説明する。図3は、図2の基板保持手段の変形例を示す図であり、基板の4辺の全てについて超音波振動を付与することを可能とする基板保持手段を示す図である。前述の実施例では、縦方向に超音波振動を加える振動子3c、3dは基板上面のみに設けられているが、図3のように、基板の下面にも振動子3e、3fを付加することにより、洗浄効果を高めることができる。さらに、前述の実施例では周波数が一定の振動子を用いているが、低周波振動子および高周波振動子の2種類の振動子を用いてもよい。たとえば、図3において、20~40kHzの低周波振動子および400kHz~1MHzの高周波振動子を、

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それぞれ図中基板の左右および上下に付設することができる。こうして、低周波振動子を作動させることにより比較的大きな異物を除去し、高周波振動子を作動させることにより微細な異物を除去することができる。この場合、2種類の振動子を別々に作動させてもよいし、同時に作動させてもよい。

【0019】なお、図2の実施例では基板の表面にほぼ平行な2つの直交方向に同時に超音波振動を付与したが、図2の場合でも2つの直交方向に交互に作用させてもよい。また、図2および図3のうちいずれの場合でも他の適当な2つの交差方向に同時にあるいは交互に作用させてもよい。なお、紫外線照射等により基板表面を親水性化した後、本発明の超音波洗浄装置を使用するとさらに高い洗浄効果を発揮することができる。

【0020】

【効果】以上説明したように、本発明の超音波洗浄装置では、超音波伝達媒体として振動吸収の少ない固体を使用しているため、基板に超音波振動エネルギーを極めて効率良く付与することができる。また、超音波振動を付与すると同時に、基板表面および基板保持手段に液体を噴射するので、超音波振動で剥離した異物は液体に取り込まれて洗浄チャンバ外に排出される。したがって、一旦除去された異物による基板の再汚染が回避され、基板保持手段の冷却が有効に行われる。さらに、基板に対して

2つの方向に同時にまたは交互に超音波振動を付与するので、異物の剥離効果が倍増する。

【図面の簡単な説明】

【図1】本発明の実施例にかかる超音波洗浄装置の構成を概略的に説明する図である。

【図2】図1の基板保持手段の構成を概略的に説明する図である。

【図3】基板保持手段の変形例を示す図である。

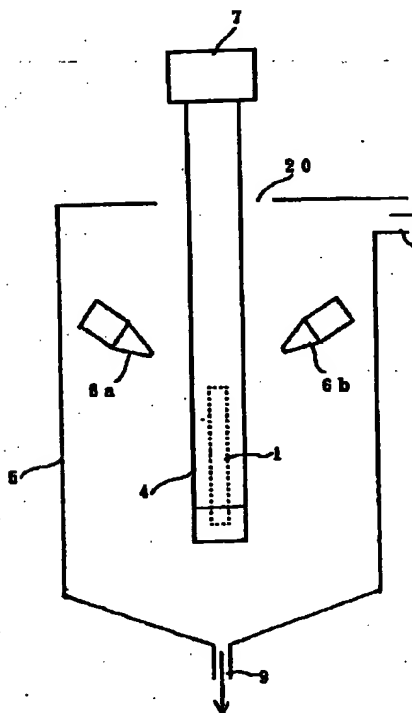
【図4】従来の液浸漬式超音波洗浄装置の構成を概略的に示す図である。

【図5】従来の液噴出式超音波洗浄装置の構成を概略的に示す図である。

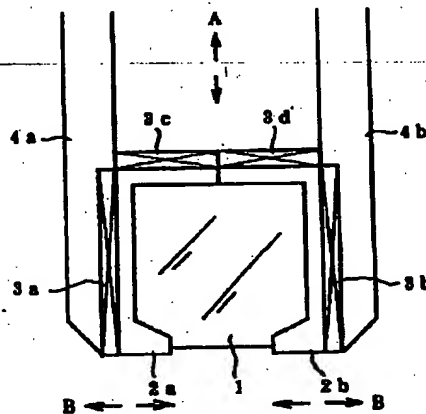
【符号の説明】

- 1 基板
- 2 基板保持部
- 3 超音波振動子
- 4 基板支持アーム
- 5 洗浄チャンバ
- 6 液噴射ノズル
- 7 駆動装置
- 8 排気口
- 9 排液口
- 20 開口部

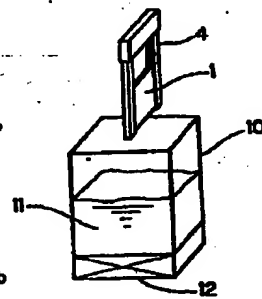
【図1】



【図2】



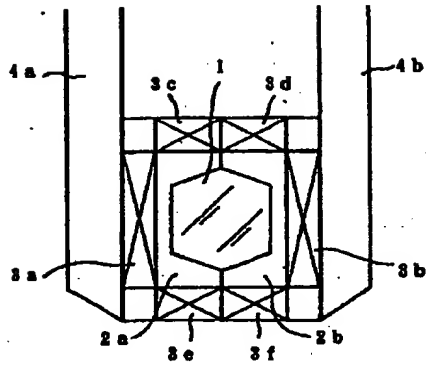
【図4】



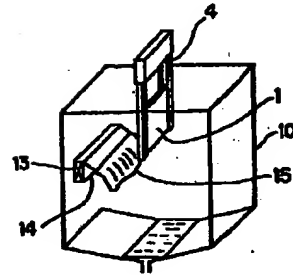
(5)

特開平7-155714

【図3】



【図5】



DERWENT- 1995-250985

ACC-NO:

DERWENT- 199533

WEEK:

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TITLE: Ultrasonic washing appts. for removing contaminants from
e.g photo mask, reticle - has liquid injection nozzle
which injects washing liquid onto surface of substrate

PATENT-ASSIGNEE: NIKON CORP[NIKR]

PRIORITY-DATA: 1993JP-0339766 (December 6, 1993)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 07155714 A	June 20, 1995	N/A	005	B08B 003/12

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
JP 07155714A	N/A	1993JP-0339766	December 6, 1993

INT-CL (IPC): B08B003/12, G03F001/08 , H01L021/304

ABSTRACTED-PUB-NO: JP 07155714A

BASIC-ABSTRACT:

The appts. has a washing chamber (5) in which a substrate (1) to be washed is placed, and held by a holder (2). The substrate is made to vibrate through the holder by an ultrasonic vibrator (3).

Subsequently, washing liquid is injected onto surface of substrate by a liquid injection nozzle (6).

ADVANTAGE - Provides vibration to substrate without attenuating energy of ultrasonic vibration substantially. Avoids re-contamination of foreign material.

CHOSEN- Dwg.1/5
DRAWING:

TITLE- ULTRASONIC WASHING APPARATUS REMOVE CONTAMINATE PHOTO MASK
TERMS: RETICLE LIQUID INJECTION NOZZLE INJECTION WASHING LIQUID
SURFACE SUBSTRATE

• DERWENT-ACC-NO: 1995-250985

Page 2 of 2

DERWENT-CLASS: P43 P84 U11 X25

EPI-CODES: U11-C06A1B; X25-H09;

SECONDARY-ACC-NO:

Non-CPI Secondary Accession Numbers: N1995-194571

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